



# **NASA**

## **Acquisition Pollution Prevention (AP2) Program and Projects**

**2006 International Workshop on  
Pollution Prevention and  
Sustainable Development**

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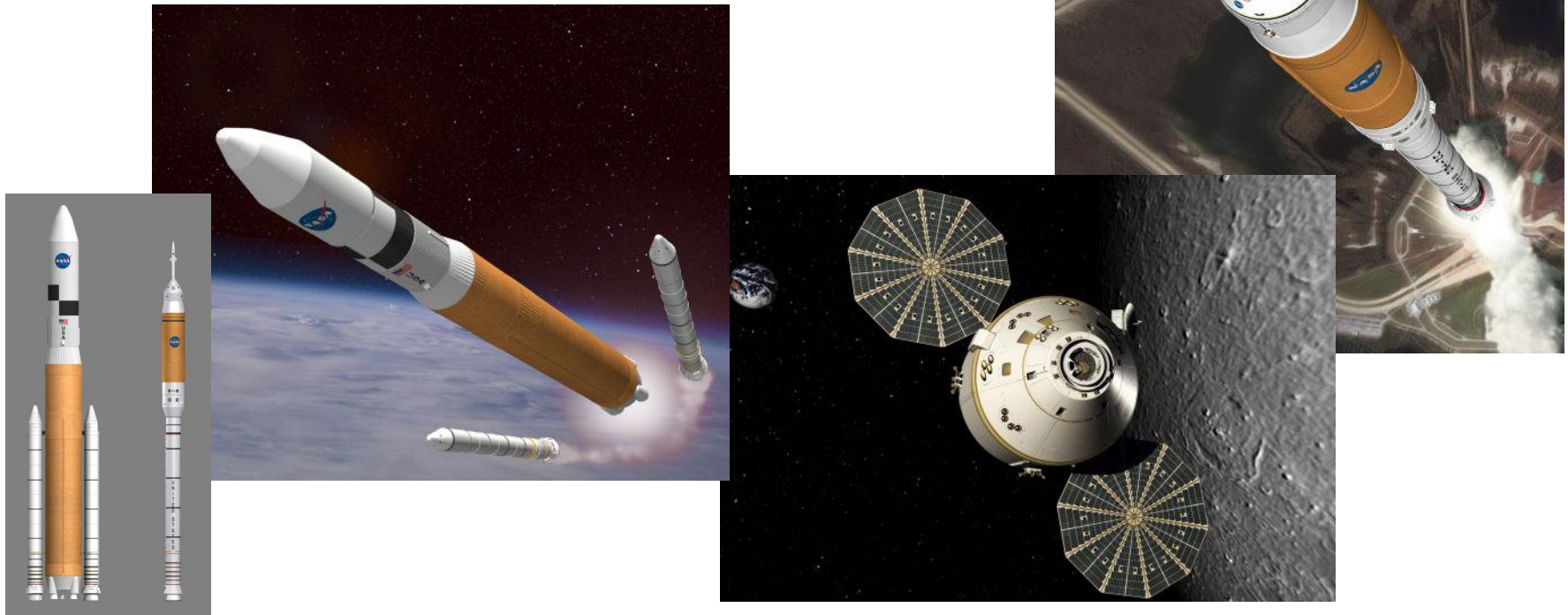
NASA Acquisition Pollution Prevention Program  
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## NASA AP2 Program Topics

Non-Chrome Projects / Status

Current Non-Chrome Coatings





## AP2 Program Background

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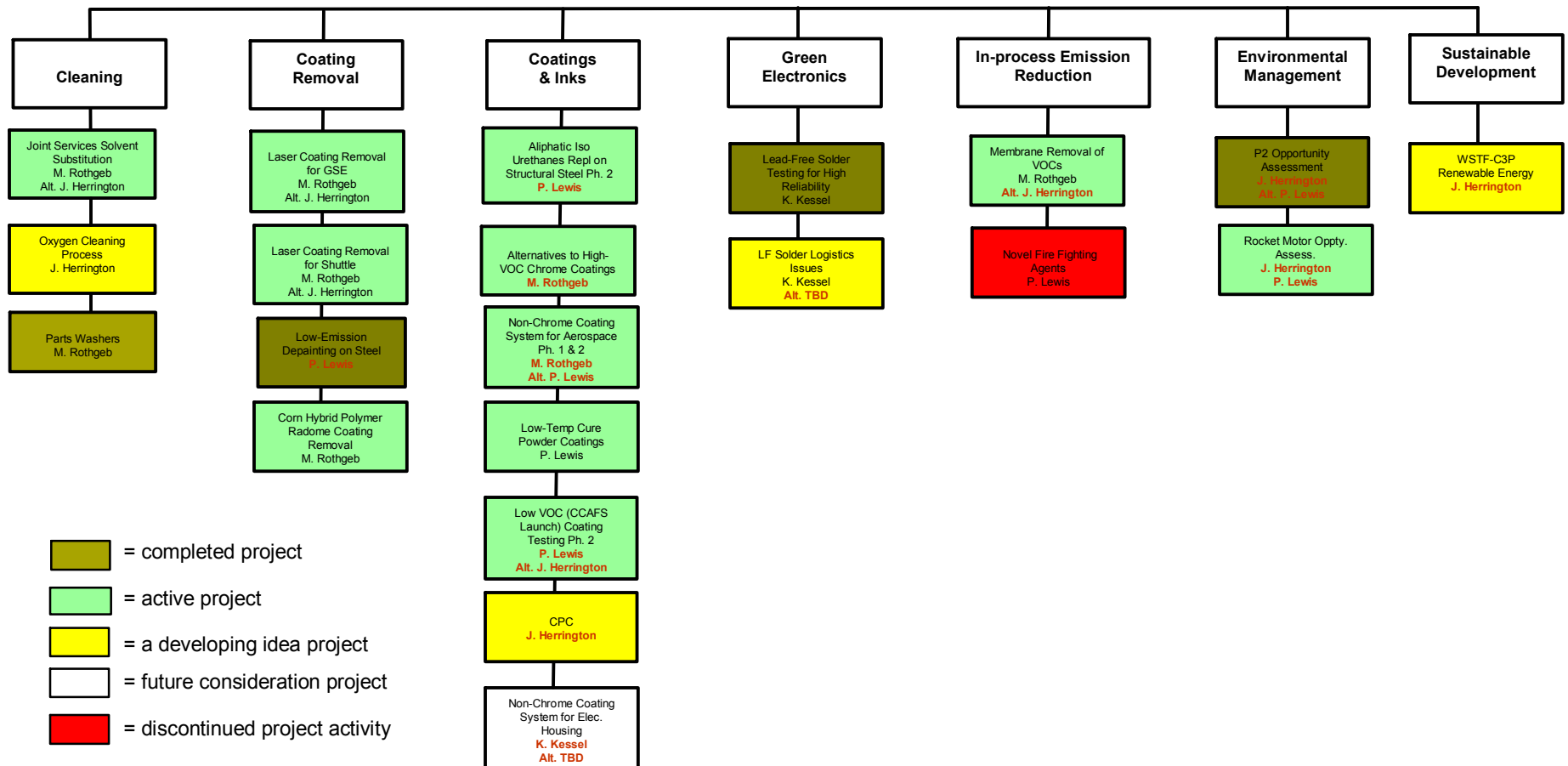
- In enacting its mission, the NASA AP2 Program operates in **three** business entities:
  - ***Agency***
    - Key Partners: Shuttle Environmental Assurance Group (SEA)
  - ***U.S. Department of Defense (DoD)***
    - Key Partners: Joint Group on Pollution Prevention (JG-PP), Air Force Space Command, AFRL, AFMC
  - ***International***
    - Key Partners: Portuguese Center for Pollution Prevention (C3P)
    - European Space Agency (ESA)



# **All Current and Developing Projects**



# AP2 Project Work Breakdown Structure Plan for FY07

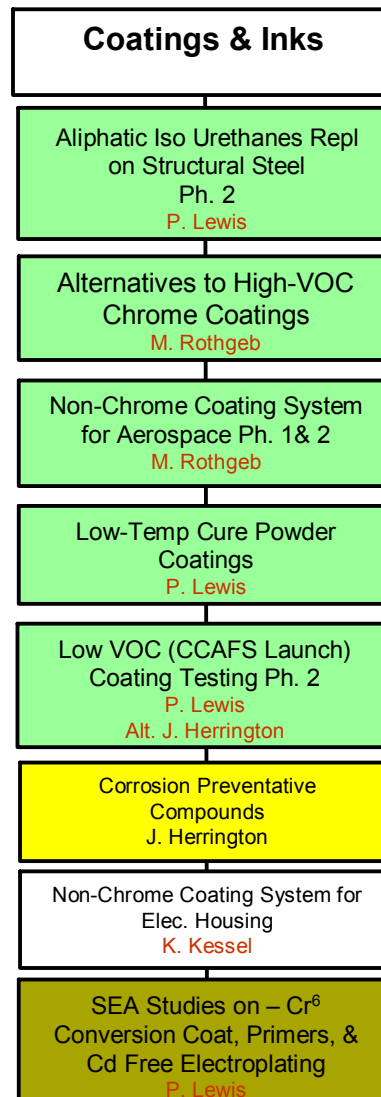


10/15/06



# Joint P2 Projects Work Breakdown Structure

## Coatings Projects





# **Current and Developing Non-Chrome Projects**

# National Aeronautics and Space Administration (NASA)



## Non-Chrome Coating System for Aerospace Phase 1 and 2 (NASA-AF)

### Description:

- Evaluation and testing of non-chromated coating systems as replacements for hexavalent chrome coatings in aircraft and aerospace applications.

### Stakeholders:

- NASA (KSC, MSFC, Boeing, RSRM, ATK Thiokol, Hill AFB, United Space Alliance, SSME, SEA)
- Air Force (Hill AFB, WPAFB AFRL & MLBT).



### Benefits:

- Meeting EPA and OSHA requirements
- Reduced maintenance cost and government liability
- Addresses NASA and Air Force requirements on AL alloys 2219, 2195, 6061, 2024 Bare, 2024 Clad, and 7075.

### FY 05 - 06 Achievements:

- Defined scope of work
- Outlined phase 1 testing requirements
- Identified project stakeholders and their respective roles and responsibilities
- Procured all materials and coated panels
- Sent panels that were finished to respective test sites so testing could begin.

### Future Plans:

- Complete Preparation of Test Panels (Nov. 2006)
- Finish the laboratory testing:
  1. Salt Spray
  2. Filiform
  3. Cyclic corrosion cabinet test
  4. Dissimilar Metals Corrosion
  5. Hydrogen Embrittlement
  6. Adhesion.





## Non-Chrome Coating System for Aerospace Phase 1 and 2 (NASA-AF)

| System | Coatings  |
|--------|---|
| T      | Alodine 5700  |
|        | Sicopoxy 577-630  |
|        | Deft 03-GY-321  |
|        | 36173(gray)/17925(gloss white)                            |
| N      | Prekote   |
|        | Mg-rich primer  |
|        | Deft 03-GY-321, 36173(gray)                               |
|        |   |
| S      | Kimetsan SPS (Degreaser)                                  |
|        | Prekote   |
|        | AquaSurTec Crosslinker (Primer)<br>AquaSurTech D45-AMS-MO |

| System | Coatings                    |
|--------|-----------------------------|
| H      | Alodine 5700                |
|        | Hentzen Primer 05510WEP-X   |
|        | Deft 03-GY-321, 36173(gray) |
|        |                             |
| C      | Alodine 1200s               |
|        | Deft 02-Y-40                |
|        | Deft 99-GY-001, 36173(gray) |
|        |                             |
| *B     | Boegel AC-131CB             |
|        | Dupont Corlar 13570S        |
|        | Deft 03-GY-321, 36173(gray) |

## National Aeronautics and Space Administration (NASA)



### Non-Chrome Coating System for Aerospace Phase 1 and 2 (NASA-AF)

| Test                          | Standard  | Pass/Fail criteria  | Stakeholder interest                              | Responsibility            |
|-------------------------------|---|---|---|---------------------------|
| Salt Spray                    | ASTM B117<br>Neutral Salt Fog on<br>Scribed, Painted<br>Substrate   | <ul style="list-style-type: none"> <li>• Class C: 3,000 hours with no evidence of corrosion (minor surface corrosion in scribe permissible).</li> <li>• Dry scrape adhesion after exposure to corrosive environment</li> </ul>  | Hill AFB F16, KSC CT                              | Hill AFB<br>KSC Corrosion |
| Filiform                      | ASTM D 2803<br>Filiform Corrosion<br>Resistance                     | All filaments < 1/4"; Majority < 1/8".  | Hill AFB F16, KSC CT, MSFC M&P                    | KSC Corrosion<br>MSFC M&P |
| Cyclic corrosion cabinet test | ASTM D 5894<br>Cyclic Corrosion Test on Scribed, Painted Substrates | <ul style="list-style-type: none"> <li>• Class C: Equivalent or improved performance compared to controls.</li> <li>• Dry scrape adhesion after exposure to corrosive environment.</li> </ul>   | MSFC M&P  | MSFC M&P                  |
| Dissimilar Metals Corrosion   | ASTM B117   | Drill and rivet the panels together with 3 anodized aluminum rivets MS20470 B5-5 on one inch centers, and expose in a 5 percent salt spray cabinet per ASTM B 117. .Visually examine each sandwich at 500 hour increments to 2000 hours exposure for corrosion, blisters, or loss of adhesion. After 2000 hours exposure, disassemble the sandwiches and examine the panels. There shall be no film defects or metal corrosion. |   | Boeing                    |
| Hydrogen Embitterment         |   | Salt Fog Testing on "Simulated Aircraft Structures"   | Hill AFB F16, KSC, MSFC M&P, Boeing, Orbiter, CEV | AFRL MLBT<br>Hill AFB     |
| Adhesion                      | ASTM B 571  |   | Hill AFB F16, KSC, MSFC M&P, Boeing, Orbiter, CEV | KSC CT                    |

# National Aeronautics and Space Administration (NASA)

## Alternatives to High-VOC Chrome Coatings for Aircraft Exteriors (C3P)



### Description:

- Demonstrate low-VOC and non-chrome coating systems on Portuguese commercial aircraft
- The identification/qualification of hex-chrome free coating systems is a Portuguese priority due to national & European safety and environmental regulations.

### Stakeholders:

- TAP Air Portugal, OGMA (Indústria Aeronáutica de Portugal), C3P and NASA AP2.



### Benefits:

- Qualification of a non-chrome paint system for application to aluminum in aerospace applications
- Decreased costs associated with environmental and occupational health/safety regulations.

### FY 05-06 Accomplishments:

- Painted exterior service door of a TAP Airbus A319 and dip-applied non-chrome pretreatment on several panels (Oct 2004)
- Two visual inspections (Jan. and Apr. 2005) appeared favorable with no visual signs of deterioration in thickness or color (**Visual inspections continue**)
- Direct and in-kind funding covers all laboratory and field testing.
- Laboratory Testing Completed in September 2006
- Results (M1-M3 Coatings failed heat stability testing – remainder of tests and coatings passed) – **NASA Tests Only**

### Future Plans:

- Continue monitoring of coating performance on service door
- Complete laboratory testing (ISQ).



## Alternatives to High-VOC Chrome Coatings for Aircraft Exteriors (C3P)

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- Six sets of panels for testing:
  - 6 System 1 (M) – (3 Original, 3 Restored)
  - 6 System 2 (P) – (3 Original, 3 Restored)

| TAP-OGMA<br>System 1 (M)  |  | TAP-OGMA<br>System 2 (P)  |  |
|---------------------------|--|---------------------------|--|
| Akzo Nobel M790E          |  | Pantheon Prekote          |  |
| Aviox Cr-free (CF) Primer |  | Aviox Cr-free (CF) Primer |  |
| Aviox Finish 77702        |  | Aviox Finish 77702        |  |



# Alternatives to High-VOC Chrome Coatings for Aircraft Exteriors – Lab Test Requirements

| Test |  | Test Method                        | Test Site  |
|------|--|------------------------------------|--|
| 1    | Gloss  | ISO 2813                           | NASA – <b>ALL PASSED</b>   |
| 2    | Initial Color  | ISO 7724 5.3                       | NASA – <b>ALL PASSED</b>   |
| 3    | Adhesion – Cross Hatch   | ISO 2409                           | ISQ  |
| 4    | Impact (reverse)   | ISO 6272                           | ISQ  |
| 5    | Flexibility – Conical Mandrel  | ISO 6860                           | ISQ  |
| 6    | Flexibility – Cylindrical Mandrel  | ISO 1519                           | NASA – <b>ALL PASSED</b>   |
| 7    | Water<br>a) Blistering<br>b) Grade<br>c) Penetration                     | ISO 4628.5<br>ISO 2409<br>ISO 1518 | a) ISQ<br>b) ISQ<br>c) ISQ   |
| 8    | Fluid Resistance – Hydraulic fluid Skydrol LD4, Hyjet IV-A or equivalent | ISO 1518                           | ISQ  |
| 9    | Corrosion Resistance - Filliform   | EN 3665 1000 hrs                   | ISQ  |
| 10   | Corrosion Resistance – Salt Spray  | ISO 7253 3000 hrs                  | NASA   |
| 11   | Artificial weathering  | ISO 2813, ISO 7724                 | ISQ  |
| 12   | Washability (cleaning efficiency)  | ISO 2813                           | ISQ  |
| 13   | Strippability  | AMS 3095 5.4                       | ISQ  |
| 14   | Restoration  | AMS 3095 5.5                       | ISQ  |
| 15   | Heat Stability   | ISO 1519, ISO 3270                 | NASA – <b>M1, M2, M3 – Failed</b><br><b>- Remainder of Coatings Passed</b> |



# Non-Chrome Coatings in Use



## Non-Chrome Coatings In-Use

| Comparison of Coating Systems Utilizing Non-Chrome |  |        |  |        |  |  |                                   |        |                              |  |                              |  |
|--|--|--------|--|--------|--|--|-----------------------------------|--------|------------------------------|--|------------------------------|--|
|  | Air Force <sup>a</sup><br>(F-15 only)  |        | AETC <sup>b</sup>                            |        | SRB  |  | Orbiter                           |        | TAP-OGMA<br>System 1         |  | TAP-OGMA<br>System 2         |  |
| Pretreat<br>ment                                   | Henkel<br>Alodine<br>1200/1600         | C<br>r | Pantheon<br>Prekote                          |        | Henkel<br>Alodine<br>5200/5700                 |  | Alodine 1200                      | C<br>r | Akzo Nobel<br>M790E          |  | Pantheon<br>Prekote          |  |
| Primer   | Deft<br>02GN084<br>Non-Cr<br>Primer    |        | MIL-PRF-<br>81733 epoxy<br>primer            | C<br>r | Hentzen<br>Epoxzen<br>Primer                   |  | Akzo-Nobel/<br>Dexter<br>10PW22-2 |        | Aviox Cr-free<br>(CF) Primer |  | Aviox Cr-free<br>(CF) Primer |  |
| Topcoat  | Deft ELT<br>(Extended<br>Life Topcoat) |        | MIL-PRF-<br>85285<br>polyurethane<br>topcoat |        | Hentzen<br>White Gloss<br>Zenthane (R)<br>Plus |  |                                   |        | Aviox Finish<br>77702        |  | Aviox Finish<br>77702        |  |



# NASA Non-Chrome Coatings for Flight Applications

| Non-Cr Pretreatments (ET)                    |    | Non-Cr Primers Only (ET)  |    | Non-Cr Pretreatments (Orbiter)  |    |
|--|----|---|----|---|----|
| MACDERMID Iridite 14-2 (CR Pretreat-Control) | Cr | Randolph Products DOD-P-15328D Green Wash Primer (Primer-Control) | Cr | Henkel Alodine 1200 (Pretreat-Control)  | Cr |
| Metalast TCP-HF                              |    | Randolph Products TT-P-645A Zinc Chromate (Primer-Control)        | Cr | Henkel Alodine 5900<br><i>Note: focus of studies due to better test results</i> |    |
| Henkel Alodine 5700                          |    | PRC Desoto Bonding Primer (Primer-Control)                        | Cr | Metalast TCP-HF   |    |
| El Dorado Dorado Kote #7                     |    | GE Shared Vision Epoxy Primer                                     |    |   |    |
| Pantheon PreKote                             |    | GE Shared Vision Polysiloxane Primer                              |    |   |    |
| Carl Chemical ECO Treat                      |    | Hentzen Primers-multiple formulations                             |    |   |    |
|  |    | Insignia's Mega Flight Mega Guard HSC Epoxy                       |    |   |    |





## Other Non-Chrome Projects



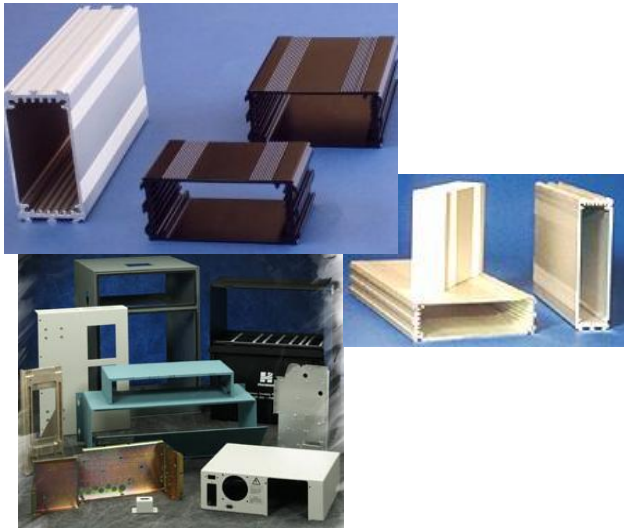
# Non-Chrome Coating System for Electronics Housings

## Description:

- Evaluation and testing of non-chromated coating systems as replacements for hexavalent chrome coatings used on electronics housings

## Stakeholders:

- NASA KSC, JPL, MSFC, JSC, GSFC, ARC, USA-SRB, Boeing-Orbiter
- Air Force, Army, Navy, Marines, Dept. of Energy
- More than 25 manufacturers and vendors.



## Benefits:

- Meeting EPA and OSHA requirements
- Meeting European RoHS requirements
- Reduced hazardous materials associated with electronics equipment

## Achievements:

- Identified potential project stakeholders and their requirements
- Project requirements survey and materials identification form sent out

## Future Plans:

- Continue to communicate with potential project stakeholders
- Continue to develop interest in the project



**Thank You!**

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